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10/824,692	04/15/2004	Mei Chen	200310075-1	8143

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EXAMINER
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SMITH, JEFFREY S

ART UNIT	PAPER NUMBER
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2624

MAIL DATE	DELIVERY MODE
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PAPER

**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

<b>Office Action Summary</b>	<b>Application No.</b> 10/824,692	<b>Applicant(s)</b> CHEN, MEI	
	<b>Examiner</b> Jeffrey S. Smith	<b>Art Unit</b> 2624	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 15 April 2004.
- 2a) ☐ This action is **FINAL**.                      2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1-55 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-55 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All    b) ☐ Some \*    c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- |  |   |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)            | 4) <input type="checkbox"/> Interview Summary (PTO-413)           |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)   | Paper No(s)/Mail Date. _____                                      |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date <u>4/04</u> .  | 6) <input type="checkbox"/> Other: _____                          |

## **DETAILED ACTION**

### ***Claim Rejections - 35 USC § 101***

35 U.S.C. 101 reads as follows:

Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

Claims 28-55 are rejected under 35 U.S.C. 101 because the claimed invention is directed to non-statutory subject matter.

For claim 28, the claimed module as disclosed on page 17 of the specification is a computer algorithm that is not embodied on a computer readable medium nor executed by a computer processor.

For claim 42, the machine readable medium is not a computer readable medium, the machine readable instructions are not computer readable instructions, and the machine is not a computer. This claim should recite a "computer readable medium storing computer readable instructions which, when executed by a computer processor, cause the computer processor to perform a method comprising...."

### ***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1-3, 11, 16-17, 28-29, 32, 37, 42-43, 46, 51 are rejected under 35 U.S.C. 103(a) as being unpatentable over Schultz et al., "Subpixel Motion Estimation for Super-Resolution Image Sequence Enhancement" published by the Journal of Visual Communication and Image Representation, v 9 n 1, pages 38-50, March 1998 ("Schultz") in view of U.S. Patent Number 7,088,773 issued to Paniconi et al. ("Paniconi").

For claims 1, 28 and 42, Schultz discloses computing a respective motion map for each pairing of a reference image and a respective image neighboring the reference image in a sequence of base images, each motion map comprising a set of motion vectors mapping reference image pixels to respective neighboring image pixels (page 38, motion vectors are estimated between video frames, where the accuracy of the estimated motion fields has a direct influence on the quality of the high resolution video still image);

Schultz discloses the target image having a target resolution level and the base images having a base resolution level equal to or lower than the target resolution level (abstract, a high resolution video still image is estimated from several low resolution frames); and

Schultz discloses computing pixel values for the target image based on corresponding pixel value contributions from the base images (see for example the Bayesian multiframe resolution enhancement discussed in section 2).

Paniconi discloses assigning respective regions of a target image to motion classes based on the computed motion maps and computing pixel values for the target

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image based on corresponding pixel value contributions from the base images selected in accordance with the motion classes assigned to the target image regions (column 2 lines 39-49, methods for motion segmentation can divide a frame into a number of motion classes, where each moving object is assigned to its own motion class).

It would have been obvious to one of ordinary skill in the art to include the motion classes of Paniconi with the super resolution enhancement algorithm of Schultz, because each class can be tracked across frames using vectors, which saves processing time as taught by Paniconi.

For claim 2, Schultz discloses generating for each image pair respective dense motion vectors describing motion at pixel locations with respective sets of parameters in a motion parameter space at sub-pixel accuracy (the entire article starting with the title and ending with the conclusion discusses this claimed element).

For claims 3, 29 and 43, Paniconi discloses assigning pixels of the reference image to respective motion classes and up-projecting the motion class assignments to pixels of the target image (see for example figures 1a, 1b and 1c which show classes projected to pixels, see also column 6 lines 1-24).

For claims 11, 32 and 46, Schultz discloses computing an alignment accuracy map for each pairing of the reference image and a respective neighboring image based on the computed motion maps (page 43, the displaced frame difference along with its

mean and variance are computed to determine how well the motion vectors have been estimated).

For claim 16, Schultz discloses up-projecting the motion maps from the base image resolution level to the target image resolution level (see page 45, the up-sampled frames produce the up-sampled subpixel resolution motion vectors).

For claims 17, 37 and 51, Schultz discloses re-mapping the neighboring images to the reference frame of the up-projected reference image using the respective up-projected motion maps (page 45, re-mapping is performed by computing the Bayesian multiframe HRVS for each motion field).

Claims 4-5, 30 and 44 are rejected under 35 U.S.C. 103(a) as being unpatentable over Schultz and Paniconi as applied to claims 1-3 above, and further in view of U.S. Patent Number 6,269,175 issued to Hanna et al. ("Hanna").

For claims 4, 30 and 44, Paniconi discloses computing motion magnitude maps from each motion map (see columns 8-9 and figures 6a, 6b, 6c, 6d, 6e and 6f, although Paniconi does not use the words "motion magnitude maps," he clearly computes the motion magnitude map for each class from the motion map as shown for example in the discussion of figure 6c), Hanna discloses multiresolution image pyramid representations that can down-sample the computed motion magnitude maps of Paniconi to a pyramid of motion magnitude maps at respective resolution levels lower than the base resolution

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level, and segment pixels in the pyramid of down-sampled motion magnitude maps into motion classes.

It would have been obvious to one of ordinary skill in the art at the time of invention to include the multiresolution image pyramid resolutions with the image enhancement and segmenting methods of Schultz and Paniconi, because the pyramid resolutions provide the benefit of very efficient computation even when large displacements are present but also provide subpixel accuracy in displacement estimates as taught by Hanna at column 6 lines 40-50.

For claim 5, Paniconi discloses segmenting, and Hanna discloses iteratively estimating pixels in the pyramid of motion magnitude maps from a coarsest resolution level up to the base resolution level, wherein estimating from each coarser resolution level is up-sampled to initialize the estimation at a finer resolution level, and refined by further estimation at the finer resolution level.

Claims 6, 12-15, 31, 33-36, 45, 47-50 are rejected under 35 U.S.C. 103(a) as being unpatentable over Schultz and Paniconi as applied to claims 1-3 above, and further in view of Eren et al., "Robust, Object-Based High-Resolution Image Reconstruction from Low-Resolution Video," published by IEEE Transactions on Image Processing, v 6 n 10, October 1997 ("Eren").

For claims 6, 31 and 45, Eren discloses generating a separate motion class segmentation map for each pairing of the reference image and a respective neighboring

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image and merging the separate motion class segmentation maps into a unified motion class segmentation map for the reference image (see pages 1448-49 and figures 1(a) and (e), the segmentation maps of each frame are given or can be computed, and the segmentation map of a reference frame is given. The maps are used to create a high resolution mosaic).

It would have been obvious to one of ordinary skill in the art at the time of invention to modify the enhancement methods of Schultz and Paniconi with the segmentation map of Eren to enable object based processing that uses more accurate motion models and improves the quality of the reconstructed image as taught by Eren in the abstract.

For claims 12, 33 and 47, Eren discloses re-mapping neighboring images to a coordinate frame of the reference image using respective motion maps, and computing correlation measures between pixels of the reference image and pixels of each of the motion-compensated neighboring images (see section III robust high-resolution reconstruction using a validity map, the correlation measure is determined over a 3x3 window of pixels between the reference image and other low resolution images).

It would have been obvious to one of ordinary skill in the art at the time of invention to modify the enhancement methods of Schultz and Paniconi with the validity map of Eren to improve the quality of the image by using projections only for those pixel locations for which the motion vectors are accurate as taught by Eren.



For claims 13, 34 and 48, Eren discloses up-projecting the computed alignment accuracy maps from the base image resolution level to the target image resolution level as discussed in section III.

For claims 14, 35 and 49, Eren discloses up-projecting the motion maps from the base image resolution level to the target image resolution level, and classifying motion vectors in each up-projected motion map into valid and invalid motion vector classes based on the up-projected alignment accuracy maps as disclosed throughout the entire document's discussion of the validity map.

For claims 15, 36 and 50, both Eren and Schultz disclose values of target image pixels with corresponding pixels in all neighboring images being associated with motion vectors in the invalid motion vector class are computed by interpolating up-projected pixel values of the reference image.

Claims 7-10, 18-27, 38-41, 52-55 are rejected under 35 U.S.C. 103(a) as being unpatentable over Schultz, Paniconi and Eren as applied to claim 6 above, and further in view of U.S. Patent Numer 6,307,560 issued to Kondo et al. ("Kondo").

For claim 7, Paniconi discloses that reference image pixels are respectively assigned to a motion class. Kondo discloses that the motion class is selected from a motion class set including a high motion class and a low motion class, and motion

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vectors assigned to the high motion class have higher magnitudes than motion vectors assigned to the low motion class (column 5 lines 18-36).

It would have been obvious to one of ordinary skill in the art at the time of invention to include the low and high motion classes of Kondo with the motion classes of Paniconi for the benefit of varying the description of the motion according to the application as taught by Kondo in column 5 line 25.

For claim 8, Paniconi discloses assigning a given reference image pixel to the low motion class in the unified motion class segmentation map when the given pixel is assigned to the low motion class in all of the separate motion class segmentation maps, and assigning a given reference image pixel to the high motion class in the unified motion class segmentation map when the given pixel is assigned to the high motion class in any of the separate motion class segmentation maps (see figures 1a, 1b and 1c each object has its own class that is tracked over multiple frames).

For claim 9, Kondo discloses that the motion class set further includes an intermediate motion class, and motion vectors assigned to the intermediate motion class have magnitudes higher than motion vectors assigned to the low motion class and lower than motion vectors assigned to the high motion class (see column 5).

For claim 10, Kondo discloses assigning a given reference image pixel to the intermediate motion class (column 5) and Paniconi and Eren disclose the unified motion class segmentation map.

For claim 18, Paniconi discloses regions of the target image are respectively assigned to a motion class selected from a motion class set (abstract) and Kondo discloses the motion classes include a high motion class and a low motion class, and motion vectors of regions assigned to the high motion class have higher magnitudes than motion vectors of regions assigned to the low motion class (column 5)

For claims 19, 38 and 52, Eren suggests computing a pixel-wise combination of pixel value contributions from the up-projected reference image and the re-mapped neighboring images weighted based on pixel-wise measures of alignment accuracy between the reference image and the corresponding neighboring images (the validity map and blurring is accounted for to determine whether pixels are aligned and contribute).

For claims 20, 39 and 53, Eren suggests that pixel value contributions from the re-mapped neighboring images are additionally weighted based on measures of temporal distance between the reference image and the corresponding neighboring images (the temporal distance is accounted for using motion vectors and the segmentation maps).

For claims 21, 40 and 54 Eren suggests classifying low motion class reference image pixels and their corresponding pixels in the neighboring images based on measures of local texture richness (see page 1449 the background is low motion that is classified based on texture).

For claim 22, Eren and Paniconi suggest low motion class reference image pixels and their corresponding pixels in the neighboring images are quantitatively evaluated for local texture richness, and are classified into a texture class selected from the texture class set including a high texture region class and a low texture region class, and pixels assigned to the high texture region class have higher local texture measures than pixels assigned to the low texture region class (see page 1448 of Eren and the abstract of Paniconi, the low motion classes can be segmented into low motion background and low motion object based on the textures).

For claim 23, Eren suggests values of target image pixels classified into the low texture region class in the reference image and all of the respective neighboring images, are computed by interpolating up-projected pixel values of the reference image (the pixel values of the background are determined from the reference image).

For claim 24, Eren and Paniconi suggest a value of a given target image pixel classified into the high texture region class in the reference image or any respective

neighboring images is computed based on a pixel value contribution from the up-projected reference image, and a pixel value contribution from a given re-mapped neighboring image weighted based on a measure of local texture richness computed for the given pixel, a measure of motion estimation accuracy computed for the given pixel, and a measure of temporal distance of the neighboring image from the reference image (the pixel values of a moving object are determined from texture, motion, and temporal images).

For claims 25, 41 and 55, Eren discloses values of target image pixels are computed based on pixel value contributions from a number of base images neighboring the reference image, and Paniconi discloses the number of neighboring base images being different for different motion classes (if an object is moving faster than another object, it will usually be present in fewer base images before it moves out of the field of view).

For claim 26, the combination of Eren, Paniconi and Kondo suggests values of target image pixels assigned to the high motion class are computed based on pixel value contributions from a fewer number of neighboring base images than the values of target image pixels assigned to the low motion class (slower objects are present in more images than faster objects).

For claim 27, Kondo suggests an intermediate motion class, the motion vectors of regions assigned to the intermediate motion class have lower magnitudes than motion vectors of regions assigned to the high motion class and higher magnitudes than motion vectors of regions assigned to the low motion class, and values of target image pixels assigned to the intermediate motion class are computed based on pixel value contributions from a fewer number of neighboring base images than the values of target image pixels assigned to the low motion class but a higher number of neighboring base images than the values of target image pixels assigned to the high motion class.

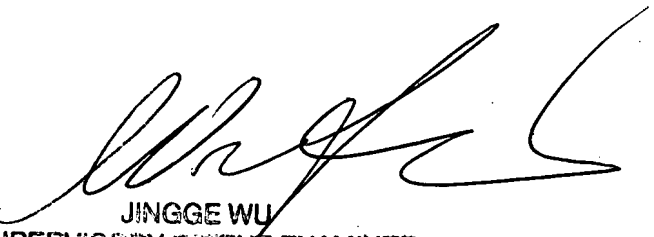
Any inquiry concerning this communication or earlier communications from the examiner should be directed to Jeffrey S. Smith whose telephone number is 571 270-1235. The examiner can normally be reached on M-F.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Jingge Wu can be reached on 571 272-7429. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

JSS  
June 4, 2007



JINGGE WU  
SUPERVISORY PATENT EXAMINER